

Exponents

Write b n times and multiply

$$\begin{matrix} \text{exponent} \\ \uparrow \\ b^n \rightarrow \text{power} \\ \downarrow \\ \text{base} \end{matrix}$$

Ex:  $5^2 = 5 \cdot 5$  ( $5^2 \neq 5 \cdot 2$ )  
 $a^4 = a \cdot a \cdot a \cdot a$

Product:  $a^n \cdot a^m = a^{n+m}$   
 Add exponents  
 Ex:  $a^5 \cdot a^3 = a^{5+3} = a^8$   
 $a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a = a^8$

- Problems:
- a.  $b^3 \cdot b^7 = b^{3+7} = b^{10}$
  - b.  $m^{10} \cdot m^5 = m^{15}$
  - c.  $a^{\frac{1}{2}} \cdot a^{\frac{1}{2}} = a^{\frac{1}{2} + \frac{1}{2}} = a^1 = a$
  - d.  $x^7 \cdot x^{-4} = x^3 = x^{7-4} \rightarrow \frac{x^7}{x^4}$

Quotient:  $\frac{a^n}{a^m} = a^{n-m}$   
 Subtract the exponents  
 Ex:  $\frac{a^7}{a^2} = \frac{\overbrace{a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a}^7}{\underbrace{a \cdot a}_2} = a^5$   
 $a^{7-2}$

- Ex:
- a.  $\frac{x^{15}}{x^7} = \frac{x^5 \cdot x^5 \cdot x^5}{x^7} = x^8$
  - b.  $\frac{a^7}{a^4} = a^3$
  - c.  $\frac{a^3}{a^5} = a^{-2} \rightarrow \frac{a \cdot a \cdot a}{a \cdot a \cdot a \cdot a \cdot a}$

Negative Exponents

Move to other part of fraction  
 $a^{-1} = \frac{1}{a}$      $\frac{1}{a^{-1}} = a$

- Ex:
- a.  $x^{-7} = \frac{1}{x^7}$
  - b.  $\frac{4x^{-2}}{y} = \frac{4}{x^2 y}$
  - c.  $\frac{x^{-3}}{a^{-5}} = \frac{a^5}{x^3}$

$\frac{x^4}{x^7} = \frac{\overbrace{x \cdot x \cdot x \cdot x}^4}{\underbrace{x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x}_7} = \frac{1}{x^3}$

$x^{4-7} = x^{-3}$

$x^{4+(-7)} = x^4 \cdot x^{-7} =$

Zero Exponents

$x^0 = 1$

$$a^7 \cdot a^5 = a^{12}$$

$$\frac{a^{10}}{a^4} = a^6$$

$$(3x^2)^0$$

$$\frac{a^{-2}}{b^1} = \frac{1}{a^2 b}$$

$$4^{-3}$$

$$\frac{1}{4^3}$$

$$4 \cdot 4 \cdot 4$$

$$\frac{1}{64}$$

$$a^{-3} = \frac{1}{a^3}$$

$$\frac{x^4 y^{-5}}{1} = \frac{x^4}{y^5}$$

$$\frac{x}{y^{-3}} = \frac{xy^3}{1} = xy^3$$

$$\frac{(-3)^{-4}}{1}$$

$$\frac{1}{(-3)^4} = \frac{1}{81} (-3)^4$$

$$\begin{array}{c} (-3)(-3)(-3)(-3) \\ \underbrace{\hspace{2em}} \quad \underbrace{\hspace{2em}} \\ (+9) \quad (+9) \end{array}$$

$$(-2)^{-3}$$

$$= \frac{1}{(-2)^{\text{odd } 3}} = -\frac{1}{8}$$

$$\begin{array}{c} (-2)(-2)(-2) \\ \underbrace{\hspace{2em}} \\ (+4)(-2) \\ -8 \end{array}$$

$$\boxed{(-5)^{-2}} = \frac{1}{(-5)^2} = \frac{1}{25}$$

$-5 \cdot -5$

$$- \boxed{5^{-2}} \rightarrow -1 \cdot \boxed{5^{-2}}$$

$$- \frac{1}{5^2} = - \frac{1}{25} \quad -5 \cdot 5$$

$$\boxed{-3^4}$$

↓

$$-81$$

$$\boxed{-5^2}$$

$$-5 \cdot 5 = -25$$

$$(-5)^2$$

$$(-5)(-5) = 25$$

$$2v u^0$$

$$2v \cdot 1 = 2v$$

$$\boxed{7a^{-1}} = \frac{7}{a}$$

$$\boxed{2b^{-2}}c = \frac{2c}{b^2}$$

$$x^5 y^{-2} = \frac{x^5}{y^2}$$

$$\frac{\boxed{7r^{-1}k^{-3}}}{\cancel{1}^0} = \frac{7}{rk^3}$$

$$c^{-3}$$

↓

$$c = -6$$

$$\frac{1}{c^3} = \frac{1}{(-6)^3} = \frac{1}{-216}$$